

between these two pines. *Pinus oaxacana* also probably crosses with some varieties of *P. montezumae*, but consideration of such behavior is beyond the scope of this paper.

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CHROMOSOME COUNTS IN SECTION ERYTHRANTHE OF THE GENUS MIMULUS (SCROPHULARIACEAE)¹

ROBERT K. VICKERY, JR., BARID B. MUKHERJEE, AND DELBERT WIENS

Brozek (1932) of Charles University, Prague, has determined the chromosome numbers of three horticultural plants of *Mimulus cardinalis* to be $2n = 16$. These counts were made in connection with his investigation of the genetics of flower color in this species. The senior author also has carried on work on the inheritance of flower color in the *M. cardinalis* complex (Vickery and Olson, 1956). In addition he is undertaking a bio-systematic study of the group. These investigations have necessitated a survey of the chromosome numbers of both the horticultural populations and the cultures of the wild races being used in these two studies. Herbarium specimens of all the cultures counted are deposited in the Garrett Herbarium of the University of Utah under the culture numbers given in Table 1.

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TABLE 1. CHROMOSOME COUNTS IN MIMULUS, SECTION ERYTHRANTHE

A. CULTURES OF NATIVE SPECIES

- n = 8 *M. lewisii* Pursh
Porcupine Flat, Mariposa County, California, altitude 8000 feet,
Sept. 17, 1948, *Hiesey* (5032).
Above Alta, Salt Lake County, Utah, altitude 8700 feet, *Vickery* 207
(5875).
- n = 8 *M. verbenaceous* Greene
Narrows Trail, Zion National Park, Washington County, Utah,
altitude 4400 feet, April, 1956, *Wiens* (5264).
Bright Angel Creek, near Phantom Ranch, Grand Canyon National
Park, Coconino County, Arizona, altitude 2000 feet, Nov. 4, 1954,
Jackson (5924).
- n = 8 *M. cardinalis* Dougl.
Beaver Creek, Siskiyou County, California, altitude 1800 feet,
Hiesey 555 (5031).

B. CULTIVATED COLOR FORMS

- n = 8 *M. cardinalis* Dougl.
5077 Royal Botanic Garden, Edinburgh, Scotland.
5078 Regional Park Botanic Garden, Berkeley, California.
5308 Botanic Garden, Halle, Germany.
5309 Botanic Garden, Basel, Switzerland.
5310 Botanic Garden, St. Gallen, Switzerland.
5311 University Botanic Garden, Liège, Belgium.
5312 Botanic Garden, Antwerp, Belgium.
5313 Botanic Garden, Wageningen, Netherlands.
5315 University Botanic Garden, Brno, Czechoslovakia.
5316 Botanic Garden, Cluj, Roumania.
5318 Botanic Garden, Copenhagen, Denmark.

Brozek made his counts from the tips of adventitious roots, fixing them in Navashin's fluid and staining them with either Heidenhain's iron haematoxylin or Cajal's magenta and picro-indio-carmine stain (Brozek, 1932). We obtained good results with the method previously described (Mukherjee, Wiens, and Vickery, 1957) which employs fixation of the buds in acetic or propionic acid followed by squashing and staining in either aceto-carmine or propio-carmine.

The sources of the horticultural color forms and of the wild cultures which we have studied are given in Table 1. The chromosome number appears to be $n = 8$ in all cases (fig. 1) although the preparations of *M. verbenaceous* (5264) showed occasional cells with apparently 9 or 10 chromosomes instead of the usual 8. The chromosomes of the 5077 culture of *M. cardinalis* were noticeably larger than the average for other races of the species (fig. 1). Those of the 5875 culture of *M. lewisii* were appreciably smaller than those of any other culture of the complex which we have examined. These size differences in the chromosomes suggest that there may be structural differences which in turn may account for the barriers to hybridization which we have observed when crossing *M. cardinalis* and *M. lewisii* (Vickery, 1956). Initially, all crosses produce vigorous F_1

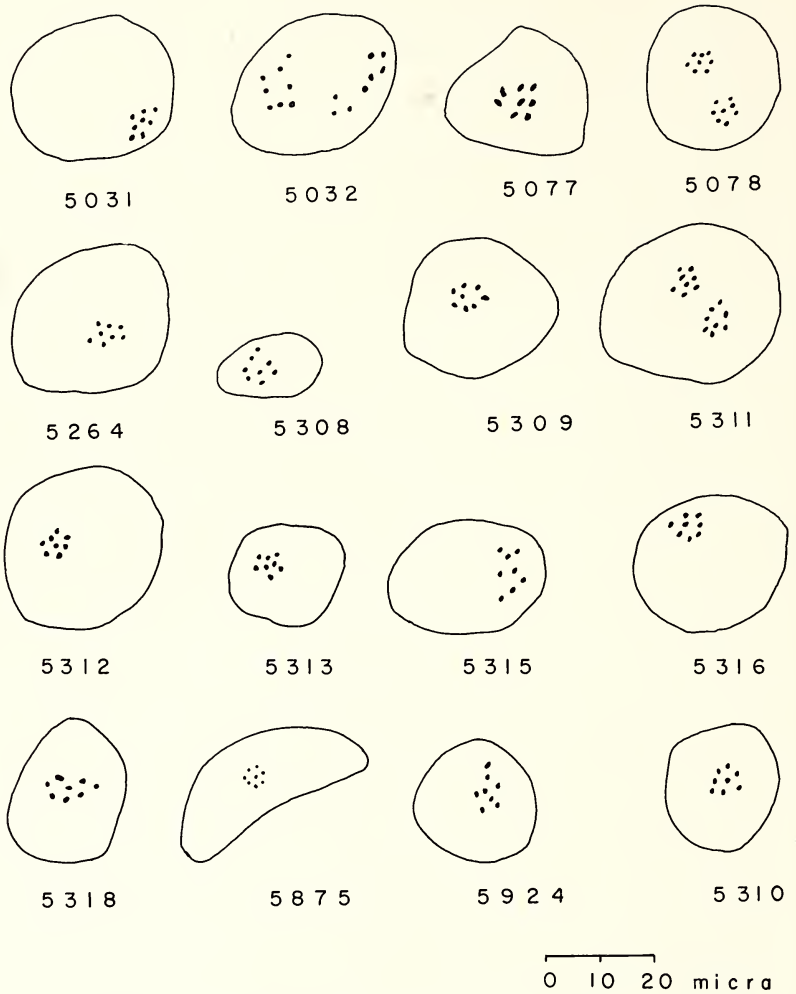


FIG. 1. Meiotic chromosomes of pollen mother cells of *Mimulus*, $\times 750$. Chromosome numbers of all the cultures are $n = 8$. Camera lucida drawings were made in all cases. The pollen mother cells of cultures 5077, 5264, 5308, 5309, 5318, and 5875 are in first metaphase whereas all the others are in second metaphase, but the two figures of the second metaphase were drawn only if the counts were clear in both nuclei.

populations but frequently the F_2 and F_3 generations are marked by decreased fertility. The crosses between *M. verbenaceus* and *M. cardinalis* and between *M. verbenaceus* and *M. lewisii* yield vigorous, fertile F_1 hybrids, also.

Combinations of *M. cardinalis* or *M. lewisii* with species of section *Paradanthus* consistently failed (Vickery, 1956). *Mimulus moschatus*

Doug., *M. primuloides* Benth., and *M. bioletti* Eastw. were used to represent section *Paradanthus*. Six different reciprocal crosses were attempted using an average of five flowers each. A *Paradanthus* intrasectional combination of *M. moschatus* and *M. floribundus* Dougl. produced vigorous but sterile F₁ hybrids. We have obtained only one chromosome count for this section: *M. moschatus*, $n = 16$ (unpublished).

On the basis of these genetic and cytological results we believe that the most natural taxonomic treatment is to group the three taxa, *M. cardinalis*, *M. verbenaceous*, and *M. lewisii*, in section *Erythranthe*. This treatment follows that of Pennell (1951) rather than that of Grant (1924) where *M. lewisii* is placed in section *Paradanthus*.

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TWO NEW SPECIES OF PENSTEMON IN COLORADO

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Since the treatment of *Penstemon* for Harrington's "Manual of the Plants of Colorado" was prepared, additional collections and study have made it necessary to recognize the following two new species for the state.

Penstemon harringtonii sp. nov. Herba perennis, glabra, 3- dm. 7 alta; caulibus erectis, simplicibus, glaucis; foliis glaucis, integris, crassis, obtusis vel acutis, mucronatis, basalibus spathulatis vel oblanceolatis, 5-7 cm. longis, 1.5-2.5 cm. latis, caulinis ceteris parvioribus, sessilibus, obovatis, elliptico-ovatis vel cordato-amplexicaulibus, ad inflorescentiam versus gradatim reductis; thyrso cylindraceo, angusto, interrupto, 5-10-fasciculato; calyce 5-9 mm. longo, lobis ovato-lanceolatis, acutis vel acuminatis, scarioso-marginatis; corolla 18-24 mm. longa, coerulea (vel rosea), bilabiata, fauce ampliata; staminibus didynamis, inferioribus